

FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

(please fill in the highlighted areas)

I. APPLICANT INFORMATION

A. Applicant Name: Custer Gallatin National Forest, Yellowstone Ranger District

B. Mailing Address: 5242 Highway 89 South

C. City: Livingston State: MT Zip: 59047

Telephone: (406) 823-6067 E-mail: csestrich@fs.fed.us

D. Contact Person: Clint Sestrich

Address if different from Applicant:

City: State: Zip:

Telephone: E-mail:

E. Landowner and/or Lessee Name
(if other than Applicant):

Mailing Address:

City: State: Zip:

Telephone: E-mail:

II. PROJECT INFORMATION*

A. Project Name: Upper Shields Yellowstone Cutthroat Trout Aquatic Organism Passage (Phase I)

River, stream, or lake: Buck Creek and Lodgepole Creek

Buck Creek	Township:	5N	Range:	11E	Section:	21
	Latitude:	46.165620	Longitude:	-110.375220	<i>within project (decimal degrees)</i>	
Lodgepole Creek	Township:	5N	Range:	11E	Section:	16
	Latitude:	46.182462	Longitude:	-110.353078	<i>within project (decimal degrees)</i>	

County: Park

Purpose of Project:

B.

Restore aquatic organism passage by installing stream simulation structures at road crossings on the two highest priority YCT streams in the Upper Shields River Drainage.

C. Brief Project Description:

Yellowstone cutthroat trout (YCT) are designated as Forest Service R1 sensitive species and Montana species of special concern due to substantial reductions in distribution and abundance within their historic range. The Shields River basin in the Crazy Mountains is a stronghold for YCT and is strategically important for their conservation range-wide. This is attributed to 250 km of occupied high elevation stream habitat at the northern extent of the species range, which provides resistance to climate change (Shepard et al. 2015).

Within the Shields River drainage, the upper basin above Crandall Creek is rated by agency biologists as the highest priority because rainbow trout are not yet present, it lies entirely within lands administered by the Forest Service, aquatic habitat is overall in good condition, and the threat of brook trout displacement of YCT can be eliminated (Shepard et al. 2015).

Currently, the Custer Gallatin National Forest has invested over \$6 million in watershed improvements in the Shields River drainage to reduce sediment delivery to streams, restore connectivity of aquatic habitats, and exclude nonnative salmonids from important YCT tributaries. Despite this work, eight culverts in the high priority upper basin above Crandall Creek remain undersized, prone to failure, and are impairing upstream fish passage to 21 miles of stream habitat. Replacement of these culverts had been delayed until it could be determined whether to replace them with barriers (to exclude brook trout) or with Aquatic Organism Passage (AOP) structures (to improve YCT and Rocky Mountain sculpin connectivity). To address this question, B.B. Shepard and Associates in cooperation with FWP, the USGS, Montana Cooperative Fishery Research Unit, and the Custer Gallatin National Forest conducted a multiyear PIT tag study. Study results indicated that: a) brook trout displacement posed an imminent threat to YCT persistence in the upper watershed; and b) YCT movement in and out of tributaries suggests the importance of maintaining and enhancing connectivity.

Informed by these study results, agency biologists have developed an incremental strategy for conserving YCT in the upper Shields River basin. It calls for first constructing a fish barrier on the mainstem Shields River immediately above the mouth of Crandall Creek, constructing temporary barriers on three tributary streams to facilitate brook trout removal and YCT rescue operations, removing brook trout, and finally restoring connectivity within tributary streams. The mainstem barrier will be constructed by August 1st, 2016, three temporary barriers have been constructed, and mechanical removal operations have commenced.

This proposal is to help fund the construction of bottomless pipe arches, one on Buck Creek and one on Lodgepole Creek to restore full aquatic organism passage. Upgrading these crossings will improve access for YCT and Rocky Mountain sculpin to 7.8 miles of habitat in the upper Shields River basin. If funded, this project will be a significant step toward the overall goal of reconnecting 28 stream miles above the Shields River fish barrier.

D. Length of stream or size of lake that will be treated:

Buck Cr: 109 feet; Lodgepole Cr: 80 feet

E. Project Budget:

Grant Request (Dollars): \$ 57,500

Contribution by Applicant (Dollars): \$ 67,500 In-kind \$ 35,000

(salaries of government employees are not considered as matching contributions)

Contribution from other Sources (Dollars): \$ 135,000 In-kind \$

(attach verification - See page 2 budget template)

Total Project Cost: \$ 260,000

F. Attach itemized (line item) budget – see template

G. Attach specific project plans, detailed sketches, plan views, photographs, maps, evidence of landowner consent, evidence of public support and fish biologist support, and/or other information necessary to evaluate the merits of the project. If project involves water leasing or water salvage complete supplemental questionnaire (fwp.mt.gov/habitat/futurefisheries/supplement2.doc).

H. Attach land management and maintenance plans that will ensure protection of the reclaimed area.

III. PROJECT BENEFITS*

A. What species of fish will benefit from this project?:

Yellowstone cutthroat trout and sculpin.

B. How will the project protect or enhance wild fish habitat?:

Eight culverts on the Shields River loop road are currently preventing or impairing upstream access to 21 of the 28 mapped stream miles in the upper Shields River drainage upstream from the site of the Shields River fish barrier (to be constructed summer 2016). By installing bottomless pipe arches, on Buck and Lodgepole Creek, this project will reconnect **7.8 miles (28%)** of native fish habitat on the two highest priority streams in the Upper Shields River drainage (**see Attachment A Upper Shields Culvert Replacement Prioritization**).

C. Will the project improve fish populations and/or fishing? To what extent?:

The project will restore unimpaired upstream movement for all age classes of YCT and sculpin, thus improving access to 7.8 miles of stream. It is unknown, whether the project will directly increase YCT abundance in the mainstem Shields River, Buck Creek, or Lodgepole Creek. However, by reconnecting 28% of the upper watershed, the probability of YCT persisting in the upper Shields River drainage will increase through reduced potential for inbreeding and increased resilience to fire and flood effects. Thus, this project will help ensure that a YCT fishery will persist in the Upper Shields into the foreseeable future.

D. Will the project increase public fishing opportunity for wild fish and, if so, how?:

By helping to ensure the long-term persistence of YCT in the upper Shields River basin, this project will maintain public fishing opportunity for wild fish. However, it is not likely that fishing opportunity will increase as a result of the project.

- E. The project agreement includes a 20-year maintenance commitment. Please discuss your ability to meet this commitment.

Both AOP's are designed to withstand the 100-year flow event and have a high probability of lasting well over 20 years with little to no maintenance. The Shields Loop road receives among the highest vehicle use on the Yellowstone Ranger District and ensuring that the crossings are functioning as designed is a high priority for the Custer Gallatin National Forest; especially as it relates to providing safe travel for the public.

- F. What was the cause of habitat degradation in the area of this project and how will the project correct the cause?:

Because both crossings are undersized, they have caused localized effects on channel morphology (aggradation upstream or scour pool formation and channel widening downstream). Characteristics of the culverts are representative of those known to impair upstream fish passage (relatively high gradient, disbursed flow, high velocities). **See Attachment B for FishXing evaluation.**

- G. What public benefits will be realized from this project?:

This project in conjunction with planned barrier construction, construction of six additional AOPs, and nonnative brook trout removal will result in 28 miles of connected Yellowstone cutthroat trout habitat secure from competition and hybridization with nonnative fish. Therefore the opportunity for the public to view and catch native Yellowstone cutthroat trout will be maintained into the foreseeable future.

- H. Will the project interfere with water or property rights of adjacent landowners? (explain):

No. Both streams are located entirely on National Forest system lands with no public water rights.

- I. Will the project result in the development of commercial recreational use on the site?: (explain):

No.

- J. Is this project associated with the reclamation of past mining activity?:

No

Each approved project sponsor must enter into a written agreement with the Department specifying terms and duration of the project.

IV. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature:

/s/ Clint Sestrich

Date:

5/31/16

Sponsor (if applicable):

***Highlighted boxes will automatically expand.**

**Mail To: Montana Fish, Wildlife & Parks
Habitat Protection Bureau
PO Box 200701
Helena, MT 59620-0701**

**E-mail To: Michelle McGree
mmcgree@mt.gov
(electronic submissions **MUST** be signed)**

**Incomplete or late applications will be rejected and returned to applicant.
Applications may be rejected if this form is modified.**

*****Applications may be submitted at anytime, but must be signed and received by the Future Fisheries Program office in Helena before December 1 and June 1 of each year to be considered for the subsequent funding period.*****

Attachment A

For a description of funding and replacement prioritization for Shields River culverts upstream from the Shields River fish barrier, please see the electronically attached word document: Upper Shields River Mainstem and Tributary Stream Culvert Prioritization and Description (Attachment A_Upper Shields Culvert Prioritization).

Attachment B

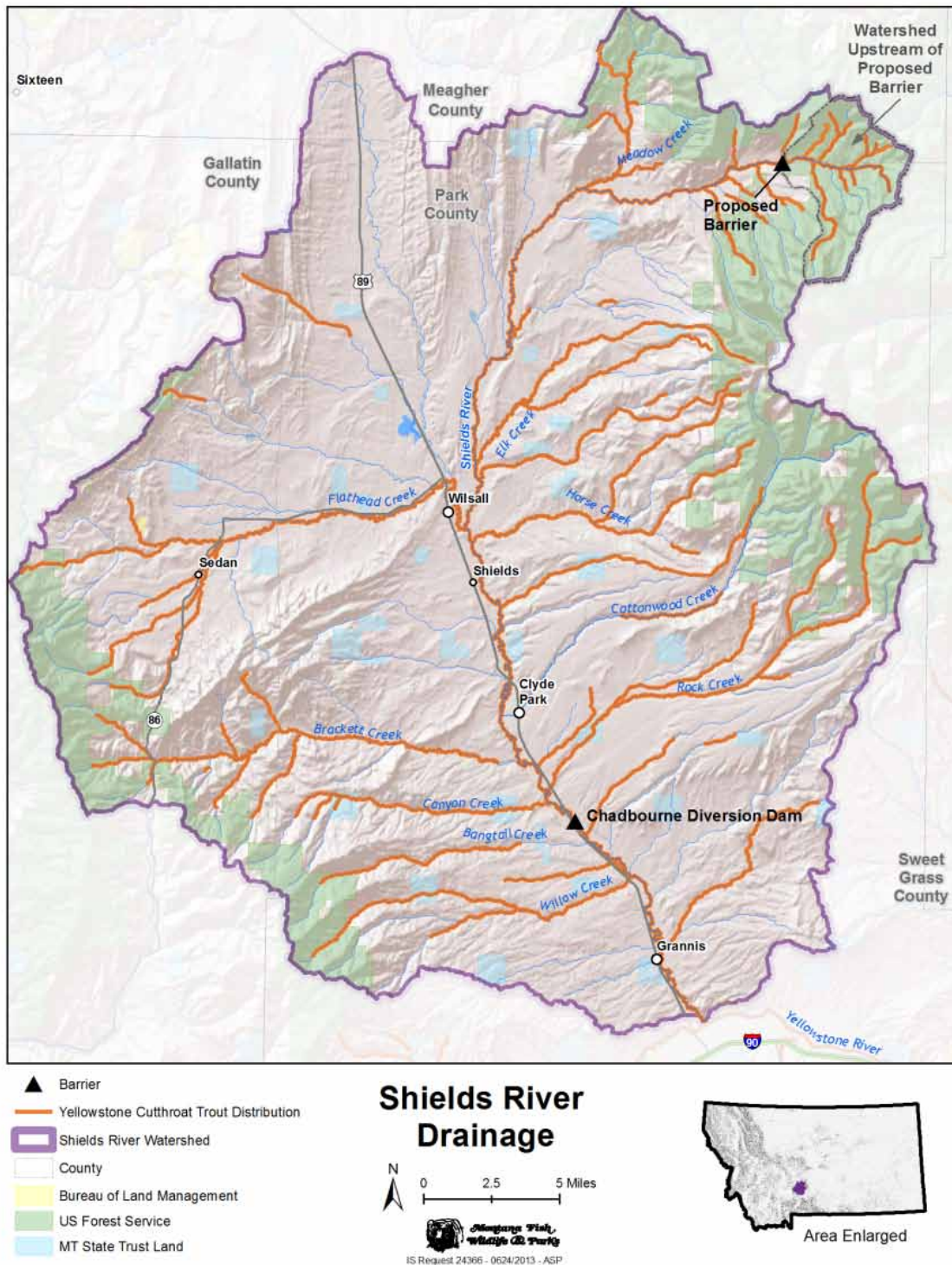
Please see the project budget in the electronically attached Excel spreadsheet. **Note, allocation of total project funds for materials, equipment, etc. are preliminary.**

Attachment C

Introduction

The upper Shields River Basin aquatic organism passage project is located

approximately 18 miles northeast from Wilsall, Montana (Map 1).

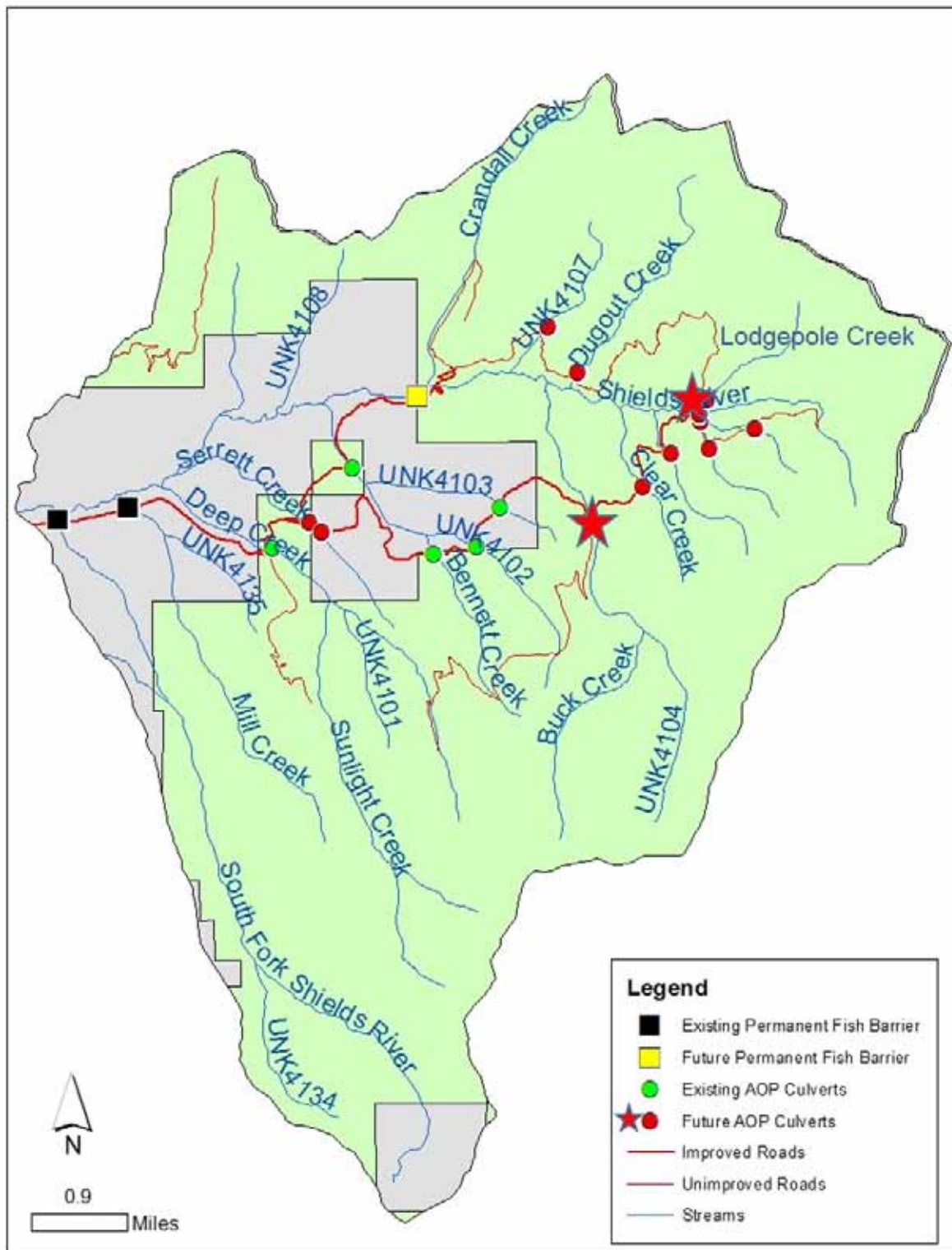


Map 1. Map of Shields River drainage showing YCT distribution, and the location of the Shields River fish barrier, above which the proposed AOP projects are located (Endicott et al. 2012).

This proposal seeks funding to upgrade the Buck Creek and Lodgepole Creek culverts to meet Forest Service aquatic organism passage (AOP) and stream simulation guidelines. These two culverts are the first of eight culverts upstream from the Shields River barrier prioritized for replacement (Attachment A; Table 1; Map 2).

Table 1. Prioritization of upper Shields culverts for replacement. Fish Passage Impairment: -1 = temporary barrier; 0 = no impairment; 1 = low-moderate impairment; 2 = highest relative impairment. Note: Because the Dugout Creek crossing is a ford with full fish passage, it was given the second lowest priority rating despite its numeric score.

Stream	Priority	Miles of Upstream Habitat	Fish Passage Impairment	Life History Importance	Fish Bearing	Total Score
Buck Creek	1	5.6	1	1	1	8.6
Lodgepole Creek	2	2.2	2	1	1	6.2
Turkey Creek Upper	3	1	2	0	1	4
Turkey Creek Trib	4	0.6	0	0	1	1.6
Scofield Creek	5	1.5	-1	0	1	1.5
Turkey Creek Lower	6	1.26	-1	0	1	1.26
Unnamed Tributary	7	1	-1	0	1	1
Dugout Creek	8	3.3	0	1	1	5.3
Clear Creek	9	1	-1	0	0	0



Map 2. Location of the proposed culvert replacements (red stars) on Buck and Lodgepole Creeks in the Upper Shields River basin in relation to the Shields River fish barrier (to be constructed summer 2016)

Baseline Conditions

Table 2. Summary of baseline geomorphic conditions in the vicinity of the Buck and Lodgepole Creek NFSR #844 crossings.

Stream	Type	Classification (Rosgen)	Average Bankfull Width (ft)	Residual Pool Depth (ft)	Upstream Gradient	Culvert Slope	Downstream Gradient
Buck Cr	Perennial	B3	15.7	2.2	4.7	0.9%	5.1
Lodgepole Creek	Perennial	B3	10.9	0.8	1.7	3.4%	2.5



Photo 1. View looking upstream from the Buck Creek culvert inlet (A) and upstream toward the Buck Creek culvert outlet (B). Photos taken May 25th 2016.

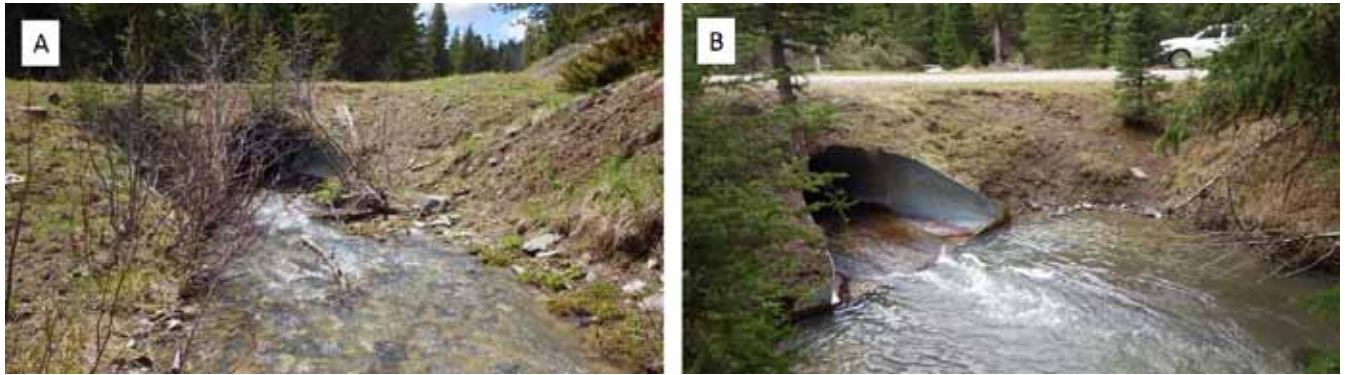


Photo 2. View looking downstream toward the Lodgepole Creek culvert inlet (A) and upstream toward the Lodgepole Creek culvert outlet (B). Photos taken May 25th 2016.

Causes of Impairments and Solutions

The existing culverts on Buck Creek and Lodgepole Creek are having localized effects on channel morphology and are impairing upstream fish passage.

Channel Morphology

Both culverts are narrow relative to the width of their adjacent stream channels. The Buck Creek culvert has an inlet width to channel width ratio of 0.57 while the Lodgepole Creek inlet width to channel width ratio is 0.64. Formation of a gravel/cobble bar at the inlet of the Lodgepole Creek culvert is indicative of culvert channel restriction (Photo 2A). Moreover both stream channels are extremely over-widened just below the culvert outlets and plunge/scour pools are evident (Photos 1B and 2B). Finally, the slope of both culverts is markedly different than the adjacent upstream and downstream slope (Table 2). The Buck Creek culvert is installed at a relatively low gradient of 0.9% relative to the upstream and downstream channel gradient of 4.7% and 5.1%, respectively. Conversely, the Lodgepole Creek culvert is relatively steep (3.4%) relative to its upstream (1.7%) and downstream channel gradient (2.5%).

Fish Passage

Parameters of existing culverts on Buck Creek and Lodgepole Creek were analyzed using program FishXing to determine flows at which depth, leap velocity, and velocity may be preventing upstream passage of juvenile and adult cutthroat trout. Depth profiles for each culvert under various flow scenarios are displayed in Figure 1. Figures 2 and 3 illustrate depths, jump velocities, and velocities within each culvert that are preventing fish passage. For Buck Creek, depth is only limiting upstream cutthroat trout passage at very low discharge. However, FishXing indicates that leap velocity and velocity are limiting upstream passage in Buck Creek under most discharges. Depth is limiting upstream adult passage in Lodgepole Creek under typical baseflow conditions. Although, there is no leap barrier on the Lodgepole Creek culvert, water velocity within the culvert is shown to prevent upstream passage of juvenile and adult cutthroat trout under most flow conditions.

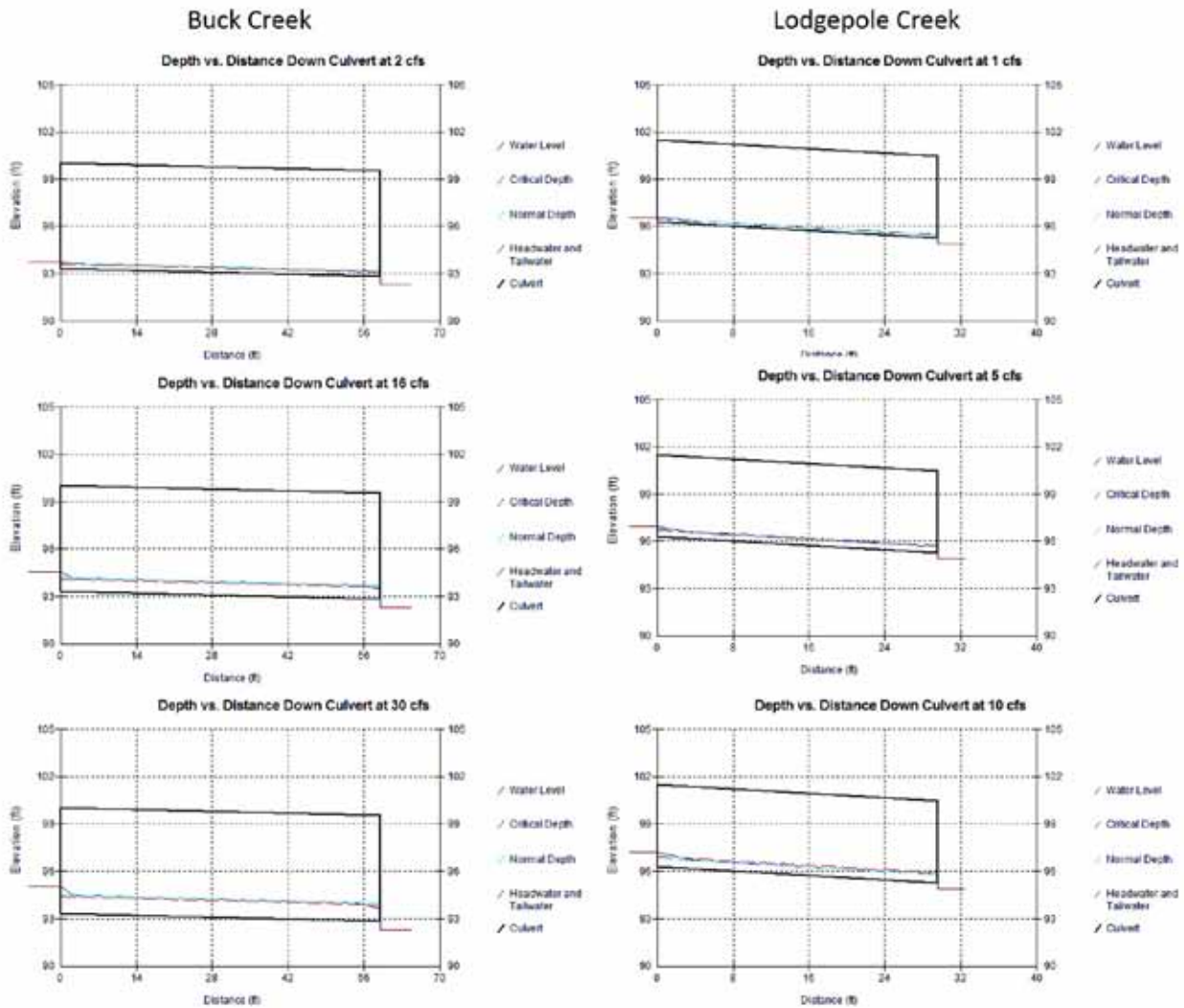


Figure 1. Profiles of existing culverts (generated from FishXing) under various design flows (Buck Creek left column, Lodgepole Creek Right column).

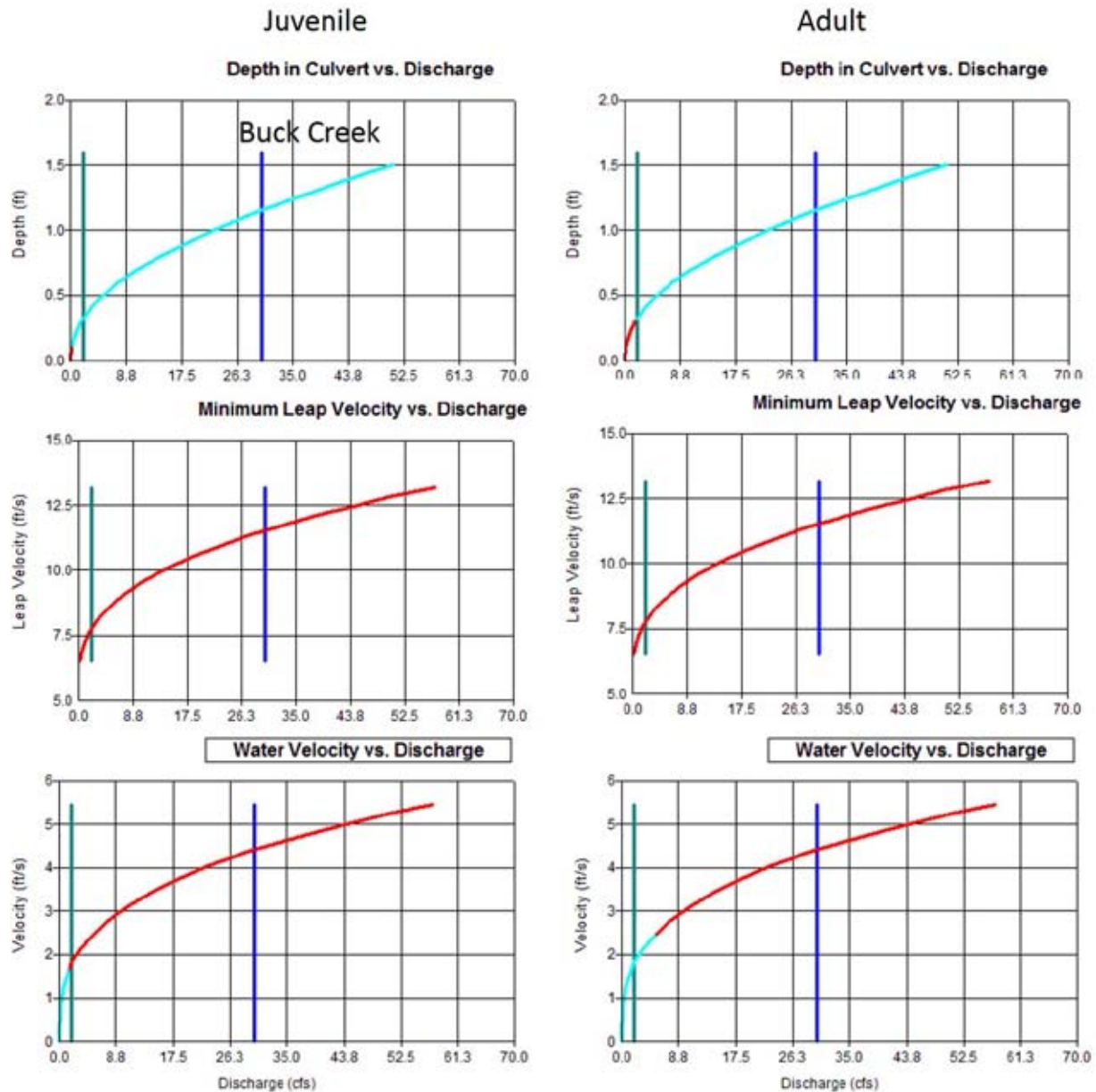


Figure 2. Modeled passage generated from FishXing for juvenile and adult cutthroat trout through the existing Buck Creek culvert for depth vs discharge, leap velocity vs discharge, and velocity versus discharge. Green = low passage design flow; Dark Blue = high passage design flow; Light Blue = passable depth, leap velocity, and velocity; and Red = impassable depth, leap velocity, and velocity.

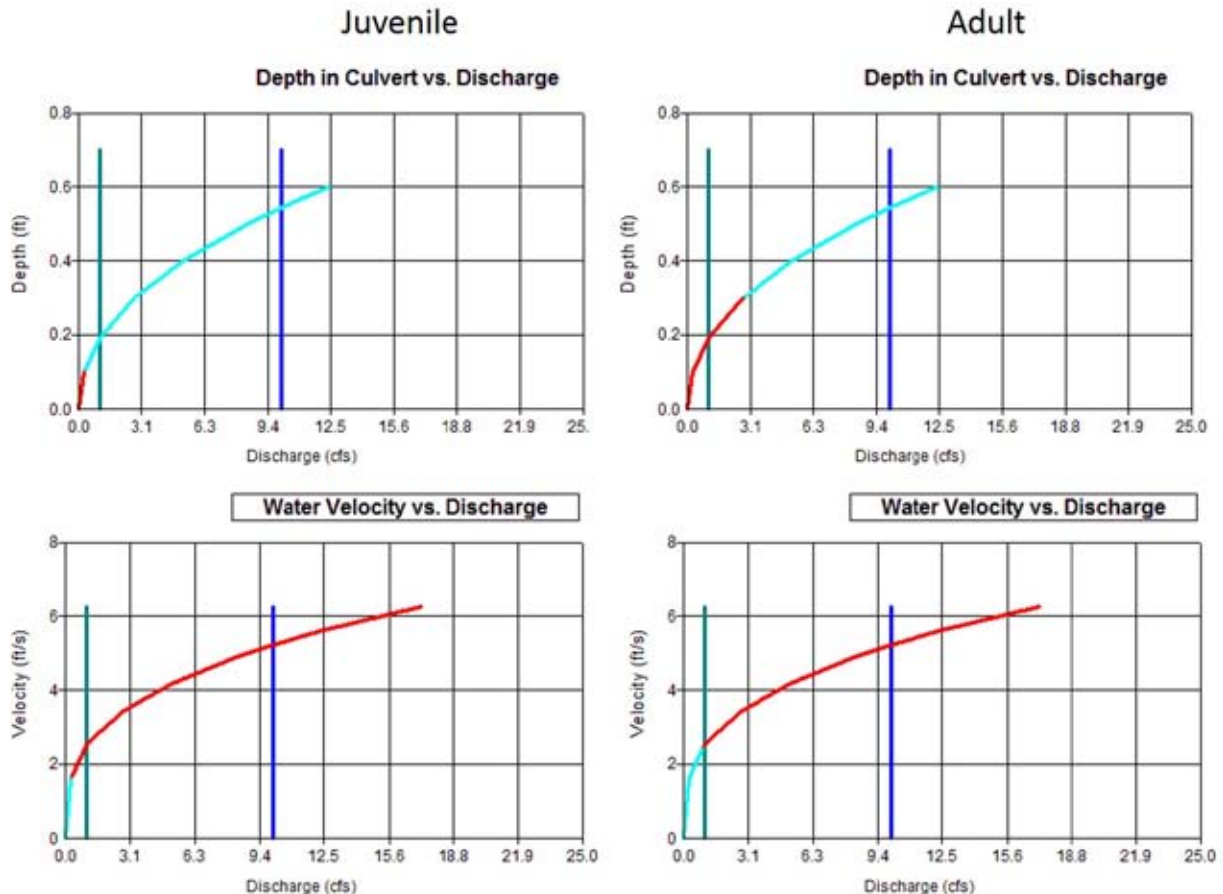
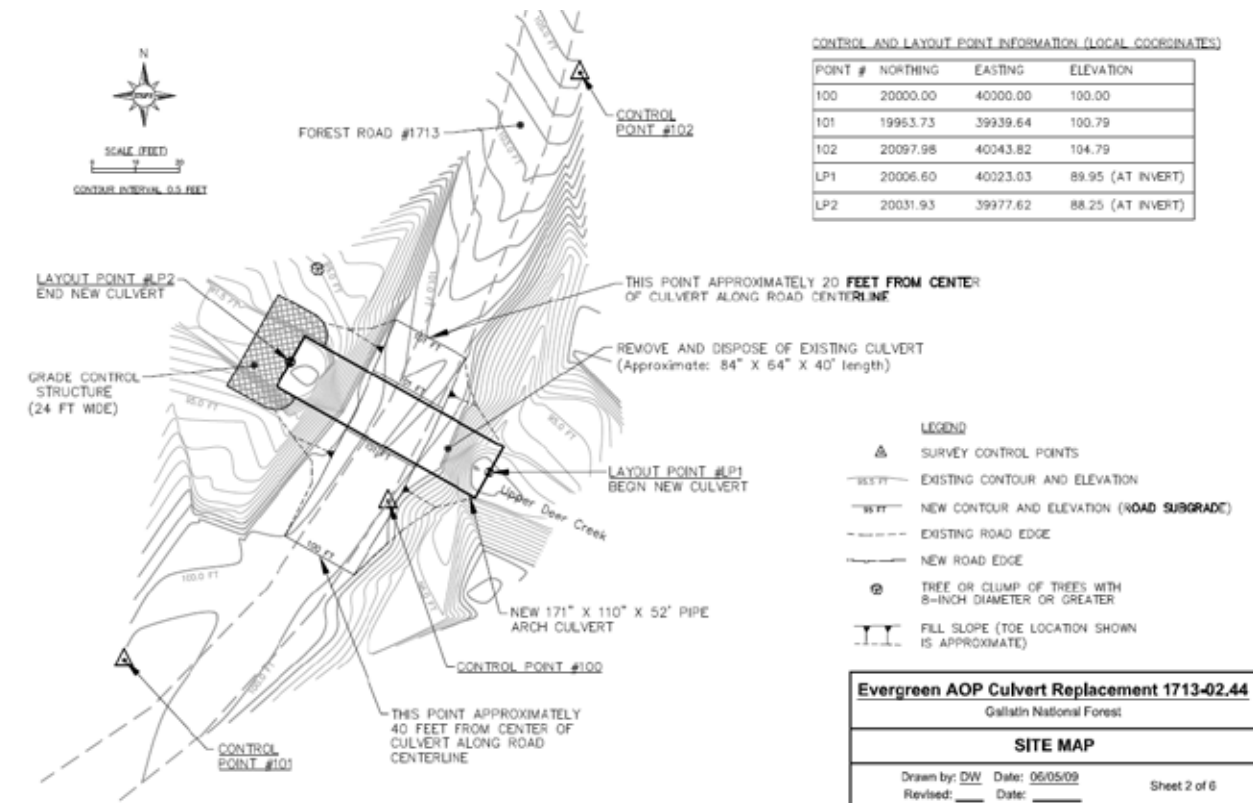
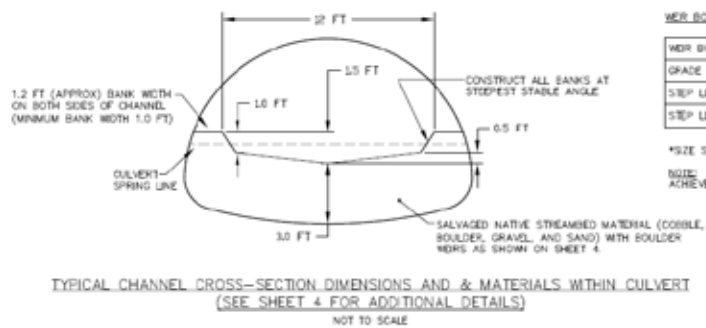
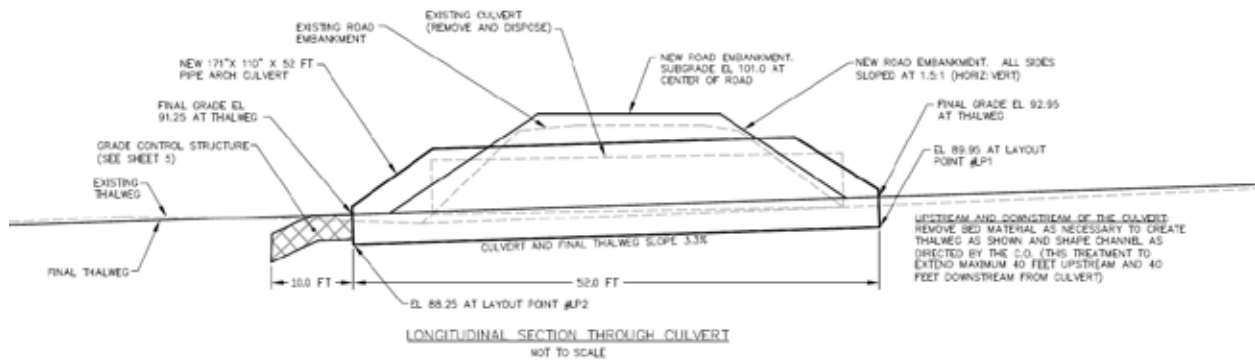


Figure 3. Modeled passage generated from FishXing for juvenile and adult cutthroat trout through the existing Lodgepole Creek culvert for depth vs discharge and velocity versus discharge (the outlet on this culvert is not perched). Green = low passage design flow; Dark Blue = high passage design flow; Light Blue = passable depth and velocity; and Red = impassable depth and velocity.

To address the existing channel morphology and fish passage issues at each of these crossings, culverts will be upgraded with AOP structures that meet Forest Service stream simulation criteria. These include passing a 100 year flow event, spanning the bankfull channel, and replicating upstream and downstream channel dimension, gradient, and substrate through the crossing. Replacement structures will be two to three feet wider than the bankfull channel and will promote upstream passage of not only Yellowstone cutthroat trout but also Rocky Mountain sculpin under most flow conditions. Because the replacement structures are approximately three feet wider than the bankfull channel, their conveyance capacity will exceed the 100-year discharge.

Although AOP designs have been completed for both crossings, they were not available at the time this proposal was prepared. Designs will be submitted upon request. Below are designs from a completed AOP structure at the "Evergreen" site on the Custer Gallatin National Forest on Upper Deer Creek. Upper Deer Creek is similar to Buck Creek and Lodgepole Creek in terms of its size and Rosgen B3 channel type.





WEIR BOULDER SIZE, GRADE CONTROL RIPRAP SIZE, AND STEP LENGTH

WEIR BOULDER SIZE*	24-30 IN.*
GRADE CONTROL RIPRAP	CLASS 5
STEP LENGTH RANGE	1.3-19 FT.
STEP LENGTH AVERAGE	16 FT.

*SIZE SHOWN IS "EQUIVALENT DIAMETER" AS DEFINED IN SECTION 101

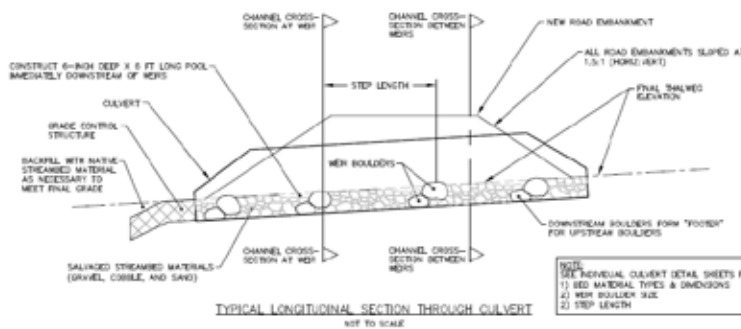
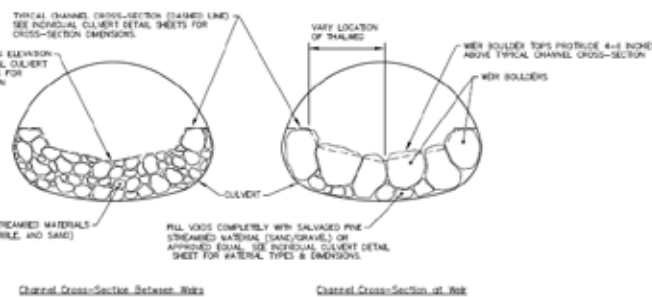
NOTE: VARY STEP LENGTH WITHIN RANGE SHOWN. ACHIEVE OVERALL AVERAGE AS SHOWN.

Evergreen AOP Culvert Replacement 1713-02.44

Gallatin National Forest

CULVERT DETAILS

Drawn by: DW Date: 06/05/09 Sheet 3 of 6
 Revised: _____ Date: _____

TYPICAL PLAN VIEW OF WEIR
NOT TO SCALE

CONSTRUCTED CHANNEL CROSS-SECTIONS INSIDE CULVERTS

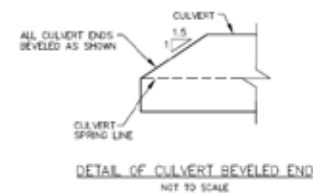
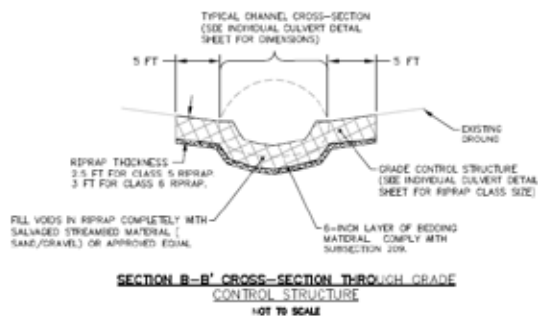
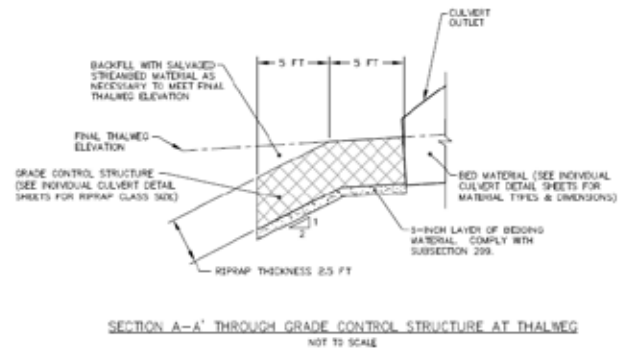
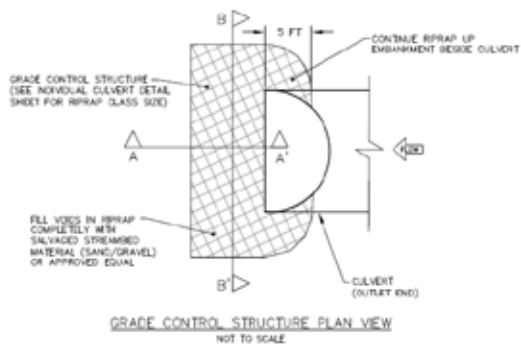
NOT TO SCALE

Evergreen AOP Culvert Replacement 1713-02.44

Gallatin National Forest

DETAILS OF STREAMBED INSIDE CULVERT

Drawn by: DW Date: 06/05/09 Sheet 4 of 6
 Revised: _____ Date: _____


Evergreen AOP Culvert Replacement 1713-02.44

Gallatin National Forest

GRADE CONTROL & CULVERT END DETAILS
Drawn by: DW Date: 06/05/02Revised: Date:

Sheet 5 of 6

Attachment D

Please find letter of support sent directly from MFWP Fisheries Biologist, Scott Opitz.



Montana Fish, Wildlife & Parks

1354 Highway 10 West, Livingston MT 59047

May 31, 2016

Ms. Michelle McGree
1420 East 6th Avenue
Helena MT 59620-0701

Dear Ms. McGree:

I am submitting this letter of support for the Future Fisheries application titled Upper Shields Yellowstone Cutthroat Trout Aquatic Organism Passage (Phase I), being submitted by Clint Sestrich with the Custer Gallatin National Forest. I am aware that Mr. Sestrich is requesting \$57,500 for the new bottomless pipe arches.

I support this project and feel that it will significantly contribute to the conservation of Yellowstone cutthroat trout in the Shields Basin. The Shields Basin currently serves as a strong hold for Yellowstone cutthroat trout across its range in Montana, yet faces threats from non-native species and habitat losses. Brook trout invasion and displacement of Yellowstone cutthroat trout is occurring at a rapid rate in the upper Shields basin. A complete fish barrier will be placed in the Shields River near Crandall Creek this summer in order to help to secure cutthroat trout in the upper basin while the threat of brook trout invasion and displacement is addressed. The proposed bottomless pipe arches are an integral part of the overall conservation effort above the barrier. The improved culverts will allow for easier passage of YCT into habitat upstream as well as passage for Rocky Mountain sculpin that are currently restricted. This project is a significant and important part of the overall Yellowstone cutthroat conservation effort in the Shields River Basin.

I strongly urge the funding of this project in order to improve and protect this valuable fisheries resource. If I can provide more information or answer any questions please feel free to contact me.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Scott Opitz', is written over a horizontal line.

Scott Opitz
Livingston Fisheries Biologist
406-222-5105
sopitz@mt.gov

cc: Sam Shepard, Region-3 Regional Supervisor
Travis Horton, Region-3 Fisheries Manager

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Both tables must be completed or the application will be returned

WORK ITEMS (ITEMIZE BY CATEGORY)	NUMBER OF UNITS	UNIT DESCRIPTION*	COST/UNIT	TOTAL COST	CONTRIBUTIONS			
					FUTURE FISHERIES REQUEST	IN-KIND SERVICES**	IN-KIND CASH	TOTAL
<u>Personnel***</u>								
Survey				\$ -				\$ -
Design				\$ -				\$ -
Engineering				\$ -				\$ -
Permitting				\$ -				\$ -
Oversight				\$ -				\$ -
				\$ -				\$ -
			Sub-Total	\$ 35,000.00	\$ -	\$ -	\$ -	\$ -
<u>Travel</u>								
Mileage				\$ -				\$ -
Per diem				\$ -				\$ -
			Sub-Total	\$ -	\$ -	\$ -	\$ -	\$ -
<u>Construction Materials****</u>								
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
			Sub-Total	\$ -	\$ 37,950.00	\$ -	\$ 133,650.00	\$ 171,600.00
<u>Equipment and Labor</u>								
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
			Sub-Total	\$ -	\$ 14,375.00	\$ -	\$ 50,625.00	\$ 65,000.00
<u>Mobilization</u>								
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
				\$ -				\$ -
			Sub-Total	\$ -	\$ 5,175.00	\$ -	\$ 18,225.00	\$ 23,400.00
TOTALS				\$ 35,000.00	\$ 57,500.00	\$ -	\$ 202,500.00	\$ 260,000.00

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

*Units = feet, hours, inches, etc. Please do not use lump sum.

**Can include in-kind materials. Justification for in-kind labor (e.g. hourly rates used for calculations). Describe here or in text.

Reminder: Government salaries cannot be used as in-kind match

***The Review Panel suggests that design and oversight costs associated with a proposed project not exceed 15% of the total project budget. If design and oversight costs are in excess of 15%, applications must include a minimum of two competitive bids for the cost of undertaking the project

****The Review Panel recommends a maximum fencing cost of \$1.50 per foot

MATCHING CONTRIBUTIONS (do not include requested funds)

CONTRIBUTOR	IN-KIND SERVICE	IN-KIND CASH	TOTAL	Secured? (Y/N)
USFWS Fish Passage Funds	\$ -	\$ 135,000.00	\$ 135,000.00	Yes
USDA Forest Service	\$ -	\$ 67,500.00	\$ 67,500.00	No
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
TOTALS	\$ -	\$ 202,500.00	\$ 202,500.00	

Upper Shields River Mainstem and Tributary Stream Culvert Prioritization and Description

Prepared by Clint Sestrich 12/9/15

Background

Efforts are currently underway to conserve the Yellowstone cutthroat trout (YCT) population in the upper Shields River Drainage in the Crazy Mountains of South Central Montana. Invasive brook trout pose the most immediate threat to YCT in the upper Shields. Over the last ten years brook trout have been rapidly increasing in abundance and distribution in the upper drainage and if left unchecked they could totally displace YCT.

Ten stream crossings in the upper watershed pose an additional threat to the YCT population which has been shown through a PIT tag movement study (Shepard 2014) to move in and out of tributary streams in fulfillment of their life history requirements. NFSR #844 crosses eight streams in the upper watershed. These include the Shields River, an unnamed tributary to the Shields River, Duggout Creek, Lodgepole Creek, Turkey Creek, Scofield Creek, Clear Creek, and Buck Creek. In addition, NFSR #6634 has an additional crossing on Turkey Creek as well as an unnamed tributary to Turkey Creek. These crossings vary in the degree to which they impair upstream fish passage, influence upstream and downstream channel morphology, and affect aquatic habitat.

To address the threat of brook trout, a fish barrier will be constructed on the mainstem Shields River at the Shields River Camp Ground in summer 2016. The barrier will allow the removal of brook trout from 27 miles of upstream habitat to proceed without the threat of reinvasion. To further facilitate the brook trout removal effort, the streambeds below the NFSR #844 culverts on the unnamed tributary, Turkey Creek, and Scofield Creek were excavated during 2013 and 2014 to create perched outlets. These three perched culverts (temporary barriers) will be used to stage removal efforts by preventing brook trout reinvasion. The seven remaining culverts will remain connected to the highest degree possible so that YCT can continue to utilize them to meet their life history requirements.

To address the existing crossings on fish passage and aquatic habitat, all crossings will be incrementally converted to aquatic organism passage structures (AOPs; Figure 1). The AOP designs, which have been completed for all crossings, will meet all Forest Service AOP standards and stream simulation criteria. These include passing a 100 year flow event, spanning the bankfull channel, and replicating upstream and downstream channel dimension, gradient, and substrate through the crossing.

All crossings have been prioritized for replacement (table 1). Crossings were ranked based on the following criteria: miles of upstream habitat, relative degree of passage impairment, importance for mainstem connectivity for fulfilling life history requirements, and whether or not they support fish. Temporary barrier crossings were given an impairment rank of -1 to ensure that they would not be replaced until all brook trout have been successfully removed upstream from the mainstem barrier. Once all crossings have been replaced, there will be 28 miles of connected YCT habitat upstream from the mainstem barrier. It should be noted that in 2016, the existing Shields River Bridge at the Shields Camp ground will be relocated to the upper Shields River crossing using fish passage funds granted to the Park County Conservation District. This work is part of the Shields fish barrier construction contract.

Table 1. Prioritization of upper Shields culverts for replacement. Fish Passage Impairment: -1 = temporary barrier; 0 = no impairment; 1 = low-moderate impairment; 2 = highest relative impairment. Note: Because the Duggout Creek crossing is a ford with full fish passage, it was given the second lowest priority rating despite its numeric score.

Stream	Priority	Miles of Upstream Habitat	Fish Passage Impairment	Life History Importance	Fish Bearing	Total Score
Buck Creek	1	5.6	1	1	1	8.6
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Turkey Creek Upper	3	1	2	0	1	4
Turkey Creek Trib	4	0.6	0	0	1	1.6
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Unnamed Tributary	7	1	-1	0	1	1
Duggout Creek	8	3.3	0	1	1	5.3
Clear Creek	9	1	-1	0	0	0

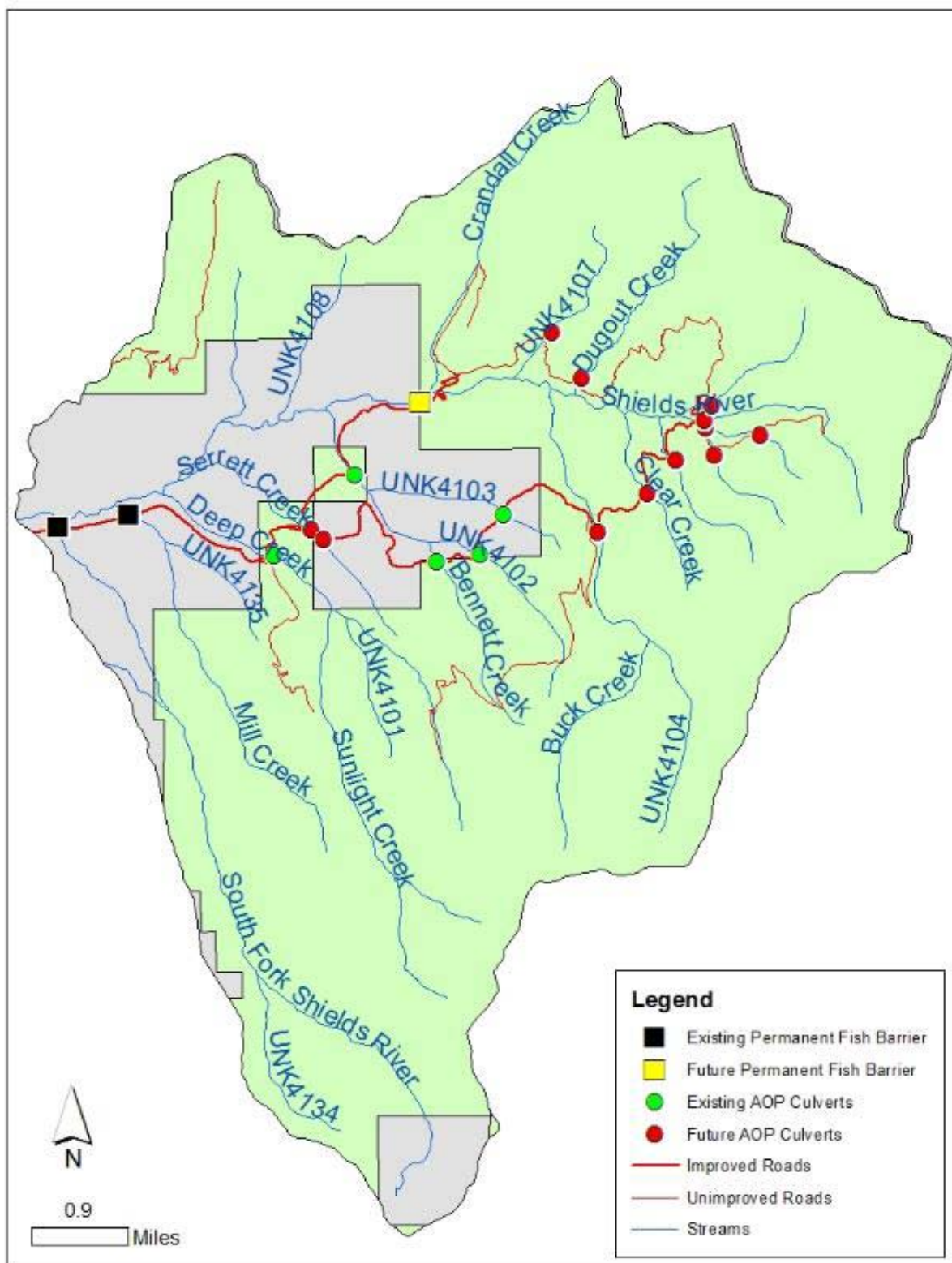


Figure 1. Map showing locations of existing permanent fish barriers and AOP culverts as well as locations of the planned mainstem Shields River fish barrier and AOP culverts.

Unnamed Tributary to Shields River Down Station From Duggout Creek

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0547541, 5115593	Round CMP	48"	Approximately 24 inches	NA

Brook trout have been present and increasing in distribution and abundance upstream from this perched culvert in recent years. During 2014, the downstream bed was excavated to create a temporary fish barrier to help facilitate the removal of brook trout. This culvert ranks low for replacement due to its role in facilitating brook trout removal.



Photo 1. The outlet of this culvert was perched by approximately two feet over a boulder.



Photo 2. Aggradation around the culvert inlet indicates that this culvert is undersized.

Duggout Creek

The Duggout Creek crossing consists of a ford. Over the past few years, the channel has incised causing the ford to be impassable to lower clearance vehicles. The AOP design for this crossing is an upgraded ford that maintains channel

dimensions necessary for fish and vehicle crossings. With no impairment to their movement, brook trout are expanding in Duggout Creek.

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0547993, 5114928	Ford	NA	NA	NA



Photo 3. The Dugout Creek ford prior to channel incision.

Lodgepole Creek

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0549926, 5114518	Squash	6'6" x 4'6"	None	NA

This is a squashed culvert with metal flared skirt at its inlet and outlet. The outlet has a small ramp that likely impairs upstream fish passage, especially during low flow conditions (Photo 4).

Brook Trout have been expanding throughout Lodgepole Creek in recent years. To address this problem, mechanical brook trout removal efforts commenced in 2014.



Photo 4. Lodgepole Creek culvert inlet (left) and outlet (right)

Turkey Creek

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0549821, 5114199	Squash	3.6' x 2.3"	36"	NA

In 2013, the streambed below this culvert was excavated to create a temporary fish barrier. After construction of the barrier, low numbers of brook trout have been found above this culvert. Subsequent mechanical removal efforts appear to have been successful at eliminating brook trout and preventing them from

becoming established. This culvert ranks low for replacement due to its role in facilitating brook trout removal.



Photo 5. The Turkey Creek culvert before and after conversion to a temporary fish barrier.

Upper Turkey Creek

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
549963, 5113788				

Turkey Unnamed Tributary

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0550644, 5114076				

The YCT assessment map indicates that this tributary is fishless. It is however connected to Turkey Creek and may occasionally support fish.

Scofield Creek

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0549382, 5113693	Squash	2'2" x 3'6"	36"	NA

In 2013, the streambed below this culvert was excavated to create a temporary fish barrier. After construction of the barrier, low numbers of brook trout have been found above this culvert. A brook trout was removed above the barrier, but eDNA testing indicates that brook trout may still be present. This culvert ranks low for replacement due to its role in facilitating brook trout removal.



Photo 6. The Scofield Creek Crossing outlet before and after conversion to a temporary fish barrier.

Clear Creek

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0548958, 5113177	Round	36"	1.7'	2.6'

No fish have been sampled in Clear Creek above or below the culvert. The culvert outlet is sufficiently perched to impair upstream passage of smaller fish, but larger fish if present may be able to pass upstream. Hand work to drain the

plunge pool could help reduce unwanted upstream passage of brook trout if present. The culvert is also undersized and misaligned. Because Clear Creek is fishless, it received the lowest rating for replacement.



Photo 7. The Clear Creek culvert inlet (left) and outlet (right).

Buck Creek

Location: WGS 84 Zone 12T	Type	Size	Outlet Drop	Plunge Pool Depth
0548232, 5112636	Round CMP	Unknown	6"	Unknown

The Buck Creek culvert is slightly perched and probably only impairs upstream passage of juvenile fish. The culvert is undersized relative to upstream and downstream wetted width (Photo 8). Brook trout and YCT are present upstream and downstream from this culvert. This culvert received the highest ranking for AOP replacement because it had by far the greatest amount of upstream habitat, is an impairment to upstream passage of some fish, and is having a localized effect on channel morphology and fish habitat.



Photo 8. The Buck Creek culvert outlet. The stream channel is noticeably wider than the culvert.